Aquaculture Industry Development Report

Estimated Costs and Returns for a Clam Grow-out Enterprise that Supplements an Existing Oyster Farm

January 1990

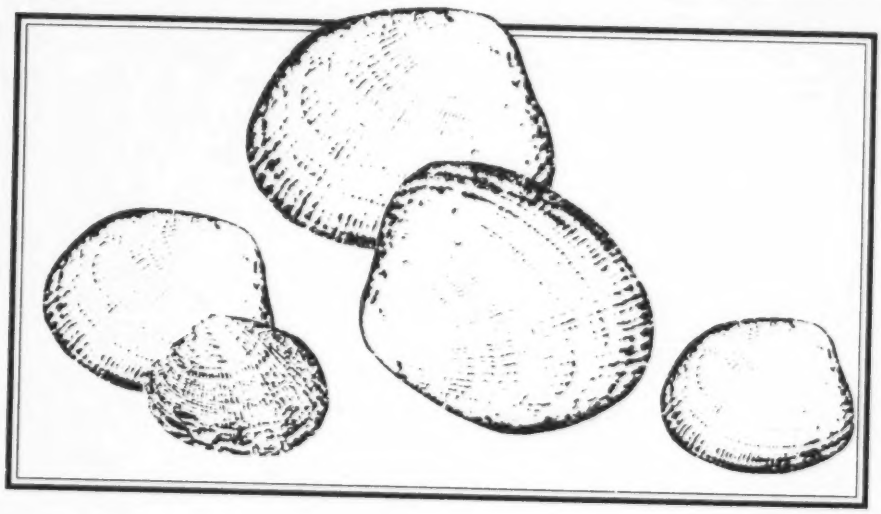

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Table of Contents

Introduction	1
General Background Information and Assumptions	2
Summary of Estimated Capital Investment for a Supplementary Clam Grow-out Enterprise Based on 2 Hectares of On-going Full Production	4
Capital Investment Assumptions and Calculations	5
Summary of Estimated Annual Costs and Returns for a Supplementary Clam Grow-out Enterprise	7
Annual Costs and Returns Assumptions and Calculations	8
Analysis	9

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W. G. Roland

P.M. Gubbels

Introduction

Objective

This study was prepared to provide estimated clam grow-out production economics information as input to the Ministry's industry development strategy for Manila clam culture. The study can be useful in targeting the major costs, biophysical concerns and the impact of price on profitability, and hence serve as a reference for development efforts. The document is being released in the hope that it will help prospective clam growers and others understand the potential and risks associated with growing clams.

Data Sources and Methodology

The assumptions and basic data for this study were developed by W. G. Roland[1] and P. M. Gubbels [2] through use of their own knowledge, consultations with other Branch staff members, clam culturists, fishermen and obtaining information from published material and supply and service firms.

A "best estimate" clam production scenario was developed, including the clam farm resource base and production and harvesting practices. Then the costs and returns associated with the scenario were estimated. This "best estimate" scenario was then used as a basis for alternative scenarios where three major factors were altered.

Draft copies of the study were distributed to research and shellfish grower reviewers for comments and suggestions[3]. Appropriate suggestions were then incorporated in this copy.

Study Use

As indicated above, this study is based entirely on estimated data for a particular clam production scenario. It is hoped that the information contained in the study is realistic and can serve as a general reference for clam enterprise planning. However, each clam enterprise will be a unique entity in terms of a large number of factors including site productivity, location, investment costs and management, production and marketing practices which result in different quantity and quality of production and different costs and returns for production. Therefore, appropriate interpretation and modification of the study data will be required. **All factors impacting on profitability, including changes in costs and prices, must be taken into account and adjusted according to different expectations and conditions.**

It is recommended that clam enterprises be initiated only after adequate clam growing trials indicate adequate site productivity and thorough business plans indicate potential profitability and financial feasibility.

Footnotes

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General Background Information and Assumptions

1. The farm:

- a 2 hectare (5 acre) clam grow-out enterprise.
- producing Manila clams (Tapes philippinarum).
- using beach culture.
- located on the west or east coast of Vancouver Island.
- on-going production of about 146,400 pounds per year.
- **the clam enterprise is a supplementary enterprise** in conjunction with an oyster enterprise. This basis was selected for the study because it appears to be the predominant way in which the clam aquaculture industry will develop during the next few years of pioneering and experimental production. As a supplementary enterprise, it is assumed that the clam enterprise will require about 25 % of the operator's time and will have capital investment allocated at 25 % for shared items.

2. Analysis type and scope:

an economic analysis providing annual costs and returns, as of January 1990, for on-going full production. Full production starts in the fourth year.

3. The clam grow-out site physical and biological profile:

a) site dimensions - 62.5 metres (205 ft) by 320 metres (1050 ft). The area is 20,000 square metres or 2 hectares (215,285 square feet or 5 acres).
b) tide level - the 62.5 metre (205 ft) width of the site is in the 1.2 metre (3.9 ft) to 2 metre (6.6 ft) range. i.e. the mid-range.
c) productive area substrate - gravel, sand, mud and shell mixture.
d) beach surface - clear of boulders etc. that might obstruct production and harvesting practices.
e) exposure to wind and waves - relatively protected.
f) water temperatures - higher than 13 degrees Celcius (55.4 degrees F) for six months of the year.
g) salinity - 24 to 28 parts per thousand.
h) minimum air temperature - killing frosts cause an estimated 40% loss of stock every 8 years. This averages 5% per year which is taken into account in specifying the total annual production.
i) existing wild populations of shellfish
   - clams - not significant.
   - other shellfish - not significant.
j) predators - crabs, moon snails, birds, flat fish, seastars.
k) site closures due to coliforms, red tide, and other causes occur occasionally but have minimal impact on yields and marketing.

In summary, the site has good characteristics for clam growth. On average, the seeded clams will reach harvestable size in 3 years. In view of the presence of predators at the site and the possibility of predator build up if the seeded clams are left unprotected, it is assumed that a predator net will be used.

4. Site access:

water access by boat only.

5. Seed description:

- 6 to 8 millimetre (.24 to .31 in.) shell length.
- received pre-counted in coolers with ice packs.

6. Cultural practices:

a) preparation of substrate for seeding - none. It is assumed that most sites will not require substrate preparation. If a site requires substrate preparation, its cost would have to be taken into account.
b) annual time of seed placement - one seeding a year during the period May to July.
c) protection from predators - before seeding, predator net, sometimes referred to as "car cover", is placed over the full area, except for a 1.5 metre (4.9 ft) path running through the middle of the site for the full 320 metre (1050 ft) length. Therefore, the total area covered by netting is 19,520 square metres. i.e. 20,000 square metres less 480 square metres for path area The net panels with attached lead line perimeters are secured to the beach with stakes.
d) seed placement - 375 clams per square metre (10.76 square ft) are placed on top of the predator net. The actual seed placement on the beach is done for about 3 hours per day just ahead of the incoming tide. The clams work their way through the net and into the substrate. The total placed = 375 clams x 19,520 square metres net covered surface = 7,320,000 clams).
e) maintenance - clearing debris, re-securing car cover, etc.
f) poacher patrol and site monitoring.

7. Estimated clam losses from all causes:

- 50 % loss over the grow-out period averaging 3 years. This is the loss rate when car cover predator

protection netting is used. Losses could be 80% or more if no predator protection is used.

8. Clam seeding rate and density:

It is assumed that no natural seeding occurs. By using this assumption, the amount and cost of seed will be high. On sites where natural seeding occurs, an adjustment could be made to reduce the amount and cost of seed .

The number of clams per square metre of beach over time is based on:

a) annual seeding of 375 - 6-8 mm (.24 to .31 in) clams per square metre (10.76 square ft).
b) the clams on average growing to harvest size in 3 years.
c) a loss rate of 50 % of the clams over three years or approximately 20.5 % per year, is Illustrated in the following table:

Group	Year 1	Year 2	Year 3	Year 4	Year 5
1	375	298	237	188*	
2		375	298	237	188*
3			375	298	237 etc.
4				375	298 etc.
5					375 etc.
Total number per square metre			**910**	**1,098****	**1,098****

* Harvested
** Reduced to 910 after the 188 clams that are older than 3 years are harvested.

9. Harvesting practices:

a) time of harvesting - any time during the year, but not within 4 months of seeding due to the unknown and possibly harmful effects of harvesting practices on the seed clams.
b) clam sizes harvested - the minimum size is above 38 millimetres (1.5 in) and the average is 44 millimetres (1.73 in).
c) method of harvesting:
- move predator netting out of the way.
- rake the clams out of substrate.
- pick out the harvestable sizes and place them in buckets.
- dump the buckets into net sacks.
- return the predator net to its previous position and secure it.
- load the sacks onto the boat.
- transport the clams to the processor.

d) volume harvested:
- 375 clams seeded per square metre (10.76 square ft) less 187.5 clams (i.e. 50% losses over 3 years) = 187.5 clams harvested per square metre (10.76 square ft).
- with an average size of 44 millimetres (1.73 in), there are 25 clams per pound.
- 187.5 clams per square metre divided by 25 clams per pound = 7.5 pounds harvested per square metre.
- 7.5 pounds per square metre x 19,520 square metres = 146,400 pounds.

e) rate of harvesting:
- with a 7.5 pound harvest yield per square metre, a good digger would dig 300 pounds per 5.5 hour tide. This is equivalent to harvesting 40 square metres per tide.

f) contract cost for harvesting:
- a good digger would likely not work for less than $120 per tide.
- $120/300 pounds per tide = $ .40 per pound.

g) method of measuring the amounts harvested:
- each worker labels the bags of clams which he/she harvests.
- the bags of clams harvested by each worker are weighed by the processor.

h) cleaning and grading: - done by processor

10 Transportation and distances:

- boat - 10 km (6.2 mi) round trip from dock to the clam lease and return.
- truck - 50 km (31 mi) round trip from dock to the processor and return.

11. Marketing method:

- sold directly to the processor who weighs, cleans and grades the clams.
- payment is based on the weight of uncleaned clams.

12. Taxes:

- the cost of items includes taxes, if applicable.

Summary of Estimated Capital Investment for a Supplementary Clam Grow-out Enterprise Based on 2 Hectares of On-going Full Production

1 Item	2 Replace cost* $	3 Years of Use	4 Salvage Value* $	5 Annual Deprec.* $	6 Annual Interest* $	7 Ref. Page*
1. lease	10,000	-	-	-	1,200	5
2. shed (25)**	5,000	30	-	167	300	5
3. truck (25%)**	5,000	5	500	900	330	5
4. boat (25%)**	5,000	10	500	450	330	5
5. motor (25%)**	1,000	3	100	300	66	5
6. predator net	23,668	5	5,000	3,734	1,720	5
7. misc. (25%)**	1,000	5	-	200	60	5
8. clam stock	202,822	-	-	-	24,339	6
TOTALS	**253,490**		**6,100**	**5,750**	**28,345**	

Notes:

* **Column 2 - Replacement Cost** - new or used cost as would be typical for producers.

* **Column 4 - Salvage Value** - trade-in or remaining value when the item ceases to be used for its original purpose.

* **Column 5 - Annual Depreciation** = (replacement cost - salvage value) / years in use.

* **Column 6 - Annual Interest** - a) for items 1 and 8 = replacement cost x opportunity cost interest rate. b) for items 2 to 7 = (replacement cost + salvage value) / 2 x the opportunity cost interest rate. The opportunity cost interest rate is the January 1990 Canada Treasury Bill rate of 12%. Division by 2 is based on the assumption that on average the items are at the mid-point of their life and capital value.

* **Column 7 - Ref. Page** - refers to the specific page on which details for the item can be found.

** These items are used jointly by the oyster and the clam enterprises. The costs shown represent a 25 % allocation to the clam enterprise.

Capital Investment Assumptions and Calculations

1. Lease:

The replacement cost of leases can vary considerably. It is estimated that $5,000 per hectare ($2000 per acre) would be required to purchase a lease with a potential annual productivity of 5 to 10 pounds per square metre.

2. Shed:

25 % of the $20,000 farm storage shed replacement cost is allocated to the clam enterprise.

3. Truck:

25% of the $20,000 pickup truck replacement cost is allocated to the clam enterprise.

4. Boat:

25% of the $20,000 boat replacement cost is allocated to the clam enterprise.

5. Motor:

25% of the $4,000 boat motor replacement cost is allocated to the clam enterprise.

6. Predator Net:

The predator net is plastic 1.9 by 1.6 centimetre(.75 by .63 in) mesh bird net commonly called car cover. It is generally available in long rolls 5.2 metre (17 ft) wide and cut into 30.5 metre (100 ft) lengths. Each 5.2 by 30.5 metre panel has lead line attached to the perimeter to hold the net in place on the beach. Allowing for a small amount of net overlap and a 1.5 metre (4.9 ft) centre path through the lease, 124 net panels (each with dimensions 5.2 by 30.5 metres) are required for the 2 hectare lease.

a) Predator net material and preparation cost.
The replacement cost for 1 panel of net with lead line attached is calculated as follows:

1 net panel 5.2 x 30.5 metre (17 x 100 ft) at $ .22 per square metre ($.02 per square ft) =	$34.89
71.4 metres (234 ft) of line with approximately .45 kilograms (1 lb) of lead per 1.8 metres (6 ft) at $ 1.35 per metre ($.41 per ft) =	96.39
nylon string to fasten the lead line to the net =	2.00
labour to cut the net into panels and fasten the lead line to the net with ties at approximately 4 metre (1.3 ft) intervals and roll the nets - 2 workers x 1.5 hours x $ 15.00 per hour =	45.00
PVC or wooden stakes (approx. 4 per panel)	.98
Total cost for 1 panel =	$179.26

The total net cost = $ 179.26 per panel x 124 panels
= $ 22,228.

b) Cost for installing the predator net on the beach. Loading, transporting, unloading, unrolling and securing the 124 predator net panels on the beach is as follows:
- 6 days x 8 hours per day x 2 workers = 96 hours.
- 96 hours x $15 per hour = $ 1,440.00

c) The replacement cost of the predator net installed on the beach is the sum of a) and b) above = $ 23,668

d) The predator net salvage value is based on the actual netting lasting only 5 years but the lead line being salvaged after the fifth year and being used for another 5 years on a second new net. The calculation is as follows: $ 96.39 cost of new lead line per panel x 124 panels x a salvage value of approximately 42 % (allowing for some labour to remove the line from the net and roll it. = $5,000.

7. Miscellaneous:

25% of the $4,000 miscellaneous equipment replacement cost is allocated to the clam enterprise. The miscellaneous equipment includes tools, wheel barrows, buckets, scales, etc.

8. Clam stock:

Since it takes 3 years to establish the clam stock before annual on-going production occurs, the establishment costs are an investment which must be carried in each year of the on-going production. One way of roughly calculating the clam stock investment is as follows:

a) Investment costs for a single year
- seed cost:
375 - 6 to 8 mm (.24 to .31 in) clams per square metre (10.76 square ft) x
19,520 square metres = 7,320,000 clams.
7,320,000 x $7 / 1,000 = **$51,240.00**
- seeding labour cost:
loading, transporting, unloading and seeding the clams on the beach -
8 days x 3 hours per day x 2 workers = 48 hours
48 hours x $15 per hour = 720.00
- other costs*:
($ 268 + $1,943+ $1,200) x 1/2 ** = **1,706.00**

Total investment cost for a single year = **$ 53,666.00**

* See the next section, Summary of Estimated Costs and Returns... Enterprise, column 2, items 4, 5 and 6.

** It is assumed that payment for these items is spread equally over the year. Therefore, investment in them is equivalent to 1/2 the total over the full year.

b) Accumulated cost over 3 years:

	Year 1 Costs $	Year 2 Costs $	Year 3 Costs $	3 Year Accumulated Costs $
Investment cost	53,666	53,666	53,666	160,998
12% compound interest on Year 1 costs	6,440	7,213	8,078	21,731
12% compound interest on Year 2 costs		6,440	7,213	13,653
12% interest on year 3 costs			6,440	6,440
Total				**202,822**

Summary of Estimated Annual Costs and Returns for a Supplementary Clam Grow-out Enterprise

1 Item Description	2 Total for 2 Hectares $	3 Per Hectare $	4 Per Pound* $	5 % of Item 10* %	6 Ref. Page*
1. RETURN at $1.15 per lb.	168,360	84,180	1.150	141.1	8
Cash operating costs:					
2. Seed	51,240	25,620	.350	42.9	8
3. Hired labour	360	180	.002	0.3	8
4. Licen., fees, prop. tax.	268	134	.002	0.2	8
5. Repair, maint.,fuel	1,943	972	.013	1.6	8
6. Miscellaneous	1,200	600	.008	1.0	9
7. Contract harvesting	58,560	29,280	.400	49.1	9
8. Total Cash OPERATING COSTS	**113,571**	**56,786**	**.776**	**95.2**	9
9. Depreciation	5,750	2,875	.039	4.8	9
10. TOTAL CASH OPERATING COSTS AND DEPRECIATION	**119,321**	**59,661**	**.815**	**100.0**	9
11. NET FARM INCOME	**49,039**	**24,519**	**.335**		9
12. Less interest on capital investment	28,345	14,172	.238		9
13. Less interest on operating capital	6,397	3,198	.044		9
14. RETURN TO OPERATOR LABOUR AND MANAGEMENT	**14,297**	**7,149**	**.098**		9

Notes

* Column 4 = Column 2 figures divided by 146,400 pounds of clams sold.

* Column 5 = (Column 2 figures divided by item 10 column 2) times 100.
i.e. the divisor is $ 119,321.

* Column 6 is the reference page on which details for the item can be found.

Annual Costs and Returns Assumptions and Calculations

1. Return:

The annual harvest is 7.5 pounds of clams per square metre x 19,520 square metres = 146,400 pounds.

Clam prices vary considerably over time due to a number of factors. A price of $ 1.15 per pound delivered to the processor is assumed. Prices have been considerably higher than $ 1.15 per pound but they could also drop below this level if industry productiion increases significantly.

146,400 pounds of clams x $ 1.15 per pound = **$168,360**

2. Seed:

375 - 6-8 mm clams per square metre x 19,520 square metres = 7,320,000 clams.

7,320,000 clams x a cost of $ 7 / 1000 = **$51,240**

3. Hired labour:

The operator hires an employee to assist with loading, transporting, unloading and seeding the clams on the beach. The cost of the hired labour, including employee CPP, UIC and WCB benefits, is calculated as follows:

8 days x 3 hours per day = 24 hours
24 hours x $15 per hour = $360

4. Licences, fees, property taxes:

Aquaculture licence
$150 x 25% allocated to the clam enterprise = 37.50

Pickup truck licence
$80 x 25% allocated to the clam enterprise = 20.00

Aquaculture lease fees
$87.50 per hectare x 2 hectare 175.00

Property taxes
-the taxation rate$8.90 per $1,000 assessed value
-the assessed lease value is $2,000 per hectare
$2,000 per hectare / 1,000 x $8.90 x 2 hectares = 35.60

TOTAL **$268.10**

5. Repair, maintenance and fuel:

Item	Replacement Cost $	Repair & Maint. Percent %	Annual R & M* Cost $	Annual Fuel Cost $
shed (25%)	5,000	2	100	-
truck (25%)	5,000	10	500	480
boat (25%)	5,000	2	100	-
boat motor (25%)	1,000	25	250	240
predator net	22,978	1	223	-
misc. equip. (25%)	1,000	5	50	-
			1,223	720.

TOTAL = $ 1,223 + $ 720 = $ 1,943

Notes

* Repair and Maintenance

6. Miscellaneous:

Truck insurance
$ 900 x 25% allocated to the clam enterprise = $ 225
General Insurance
$ 400 x 25% allocated to the clam enterprise = 100
Moorage
$ 720 x 25% allocated to the clam enterprise = 180
Telephone
$ 960 x 25% allocated to the clam enterprise = 240
Accounting
$ 600 x 25% allocated to the clam enterprise = 150
Business expenses re: meetings, conventions, etc.
$ 600 x 25 % allocated to the clam enterprise = 150
Other including supplies, subscriptions, etc.
$ 620 x 25% allocated to the clam enterprise = 155

TOTAL = 1,200

7. Contract harvesting:

$120 per tide per contract worker / 300 pounds of clams harvested per worker per tide = $ .40 per pound of clams harvested.

7.5 pounds of clams harvested per square metre per year x 19,520 square metres harvested x $ .40 per pound contract harvesting cost = a total contract harvesting cost of **$58,560.**

8. Total cash operating costs:

The sum of the totals for items 2 to 7 above.

9. Depreciation:

See the above section ***Summary of Estimated Capital Investment for a Supplementary Clam Grow-out Enterprise Based on 2 Hectares of On-going Full Production , the total for column 5.***

10. Total Cash Operating Costs and Depreciation:

The sum for items 8 and 9 above.

11. Net Farm Income:

The net farm income is calculated by subtracting the total cash operating costs and depreciation from the total return, i.e. item 1 minus item 10.

The net farm income is the residual return to operator labour, management and investment.

12. Interest on capital investment:

See the above section *Summary of Estimated Capital Investment for a Supplementary Clam Grow-out Enterprise Based on 2 Hectares of On-going Full Production,* the total for column 6.

13. Interest on operating capital:

In calculating the interest on operating capital it is assumed that items 2 and 3 are purchased at the beginning of the year and accrue interest for one year, whereas, items 4, 5 and 6 are purchased at the midpoint of the year and accrue interest for 1/2 a year.

The calculation of interest on operating capital is the sum of (item 2 + item 3 + (items 4 + 5 + 6) x 1/2) x 12 % interest. i.e.
($ 51,240 + $ 360+ ($ 268 + $1,943 + $ 1,200) x 1/2) x .12 = **$ 6,397.**

14. Return to Operator Labour and Management:

This is the residual return to operator labour and management calculated by subtracting the opportunity cost interest on capital investment and operating capital from the net farm income.

Operator labour and management involves a large number of activities including: clam seeding, removing debris from the clam bed, monitoring the stock, poacher patrol, supervising the contract clam diggers, record keeping, business planning and other management functions. As noted in the *General Background Information and Assumptions* section, the clam enterprise is a supplementary enterprise requiring about 25 % of the operator's time. This is estimated to be about 600 hours of operator time each year. With this assumption, the $14,297 return to operator labour and management for the clam enterprise represents a return of $23.83 per hour. i.e. $ 14,297 / 600 hours = $23.83.

Analysis

1. Alternative Scenarios:

Three factors, clam price, survival rate and harvesting cost, can have a dramatic impact on the outcome of a clam enterprise. The price received for the clams could be considerably lower or higher than the $1.15 price used in the study. Likewise, this study has assumed a clam survival rate of about 50 % over the average three year growth period. However, the clam survival rate, and consequently the clam yields, could be considerably lower or higher. Also, the cost of harvesting could be considerably different from the $.40 per pound used in this study. Generally, the lower the clam density the higher the harvesting cost per pound and conversely, the higher the clam density the lower the harvesting cost per pound.

To illustrate the estimated net farm incomes per hectare for a range of alternative clam prices, clam yields and harvesting costs, the following table is presented:

Clam Enterprise Estimated Net Farm Income per Hectare With Alternative Prices and Yields*

Annual Clam Yields (lb./sq. m.)	Prices per pound of harvested clams				
	$.95	$1.05	$1.15	$1.25	$1.35
5.0 **	-13,301	-8,421	-3,541	1,339	6,219
7.5	9,879	17,199	24,519	31,839	39,159
10 ***	33,059	42,819	52,579	62,339	72,099

Notes

* The figures in this table are based on the Summary of Estimated Annual Costs and Returns ... Clam Grow-out Enterprise. All costs are assumed to be constant except for contract harvesting costs which were calculated at $ .60, $.40 and $ .30 per pound respectively for the 5.0, 7.5 and 10. pound yields per square metre.

** The 5 pound yield per square metre represents a clam survival rate considerably less than 50% over the average three year grow-out period.

*** The 10 pound yield per square metre represents a clam survival rate considerably higher than 50 % over the average three year grow-out period.

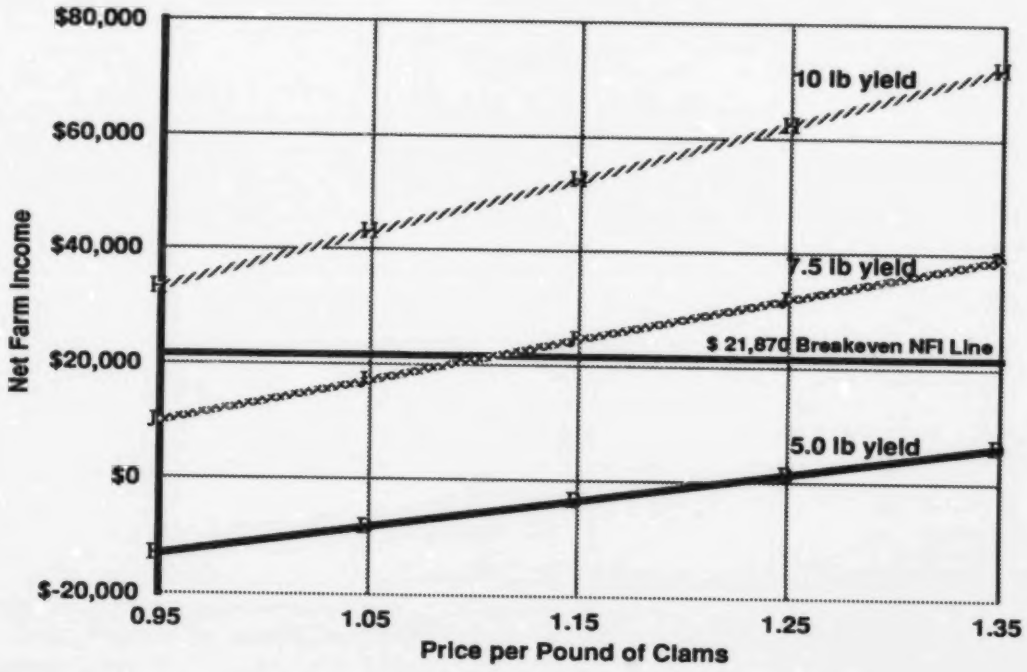
2. Breakeven net farm income:

To illustrate the above table with a breakeven net farm income, a line graph is presented on the following page.

The the graph shows a breakeven level of net farm income. It indicates the level required in order to attain specified returns to operator labour and management, interest on capital investment and interest on operating capital. It is based strictly on **imputed or specified data,** hopefully at levels that would be realistic goals for those considering developing a clam enterprise. The breakeven net farm income used on the graph was derived as follows:

300 hours of operator labour and management per hectare x $15 per hour =	$ 4,500
Interest on capital investment per hectare (see page 10, Summary of Estimated Clam ... Returns, item 12, column 3).	14,172
Interest on operating capital per hectare (see page 10, Summary of Estimated Clam ... Returns, item 13, column 3).	3,198
TOTAL per hectare =	**$ 21,870**

Clam Enterprise Estimated Net Farm Income Per Hectare With Alternative Prices and Yields



3. Interpretation of the graph:

At an annual yield of 5 pounds of clams per square metre, the breakeven net farm income will not be attained at any of the prices per pound shown.

At an annual yield of 7.5 pounds of clams per square metre, the breakeven net farm income is attained at a price of approximately $1.11 per pound. Below this price the specified net farm income is not attained and above the $ 1.11 price per pound a higher than specified net farm income is attained.

At an annual yield of 10.0 pounds of clams per square metre, the breakeven net farm income is attained at all the prices shown.

4. Effect of Seed Cost and Natural Seeding on Net Farm Income:

Factors such as clam seed supply and demand or on-site nursery rearing of seed may increase or decrease seed costs. The effect would be a proportional increase or decrease in net farm income.

Natural seeding would either increase production or allow the seeding rate to be decreased. Increased production would increase net farm income by increasing the sales of clams. Decreasing the seed rate would increase net farm income by reducing the seed costs. It would be important that the combination of artificial clam seeding and natural seeding result in an optimum stocking density to effectively use the carrying capacity of the beach.

5. Concluding comment:

With the present level of clam culture knowledge, differences in management ability and a range in clam prices that might be expected in the future, it is likely that the outcomes for those who attempt to develop clam culture enterprises could vary considerably. The outcomes could range from highly successful businesses to unfortunate business failures. Potential clam growers will need to consider very carefully the opportunities and the risks associated with developing a clam enterprise.